STATE OF NEVADA
DEPARTMENT OF CONSERVATION AND
NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

AMBIENT AIR QUALITY TRENDS

1989-2000

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TABLE OF CONTENTS

L I S T O F T A B L E S

LIST OF TABLES (Continued)

LIST OF APPENDICES

LIST OF APPENDICES (Continued)

INTRODUCTION AND SUMMARY

The primary emphasis of this Trend Report is to present data on monitoring for various airborne pollutants and identify trends in these pollutant levels. The United States Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS). The EPA set these standards to protect human health and welfare. Primary standards are designed to protect human health, including sensitive populations such as the elderly and children. Secondary standards protect public welfare and address the effects of air pollution on vegetation, materials, and visibility.

Air pollution comes from a variety of sources. These include "stationary sources," such as factories, power plants and smelters; smaller sources, such as dry cleaners and degreasing operations; "mobile sources," such as cars, trucks, buses, trains and planes; and "natural sources," such as windblown dust and wildfires.

The six principal air pollutants ("criteria" pollutants) with primary standards are carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (with an aerodynamic size less than or equal to 10 microns, or PM_{10}, and with an aerodynamic size less than or equal to 2.5 microns, or $PM_{2.5}$), and sulfur dioxide (SO_2). Effective September 16, 1997, new standards for eight-hour ozone concentrations and for particulate matter less than or equal to 2.5 microns in size ($PM_{2.5}$) were added to the list of standards for the principal pollutants. The finer particle size standards for $PM_{2.5}$ provide increased protection against a wide range of health effects related to respiration of particulate matter. Monitoring for the new $PM_{2.5}$ standards began in 1999.

The State of Nevada has its own air quality standards that are generally based on the federal standards for air quality. In addition to the state standards for the criteria pollutants, Nevada has an air quality standard for the non-criteria pollutant hydrogen sulfide (H_2S), which is a toxic gas characterized by a disagreeable odor. Monitoring for hydrogen sulfide is generally confined to the proximity of industrial sources of this pollutant.

The Nevada Revised Statute 445B.100 establishes public policy regarding air quality in Nevada. This statute states:

> *It is the public policy of the State of Nevada . . . to achieve and maintain levels of air quality which will protect human health and safety, prevent injury to plant and animal life, prevent damage to property, and preserve visibility and scenic, esthetic and historic values of the state.*

One goal of the Nevada Division of Environmental Protection, Bureau of Air Quality, and the air quality agencies of Washoe County and Clark County, is to determine current and projected concentrations of ambient air contaminants within the state, and to develop and implement measures by which the ambient air quality standards will be achieved and maintained.

Continuing increases in the population base and industrial community necessitate measures to control the attendant deterioration of the air quality. Programs requiring air quality operating permits for stationary sources of air pollution minimize the pollution of the air by industrial facilities. Similarly, an inspection and maintenance program for the urban areas of Reno and Las

Vegas is in place to reduce harmful automotive exhaust emissions from mobile sources.

There have been important successes in counteracting the tendency toward worsening air quality with growth. The most significant success has been the improvement in levels of lead pollution in the ambient air after the elimination of lead from gasoline. There were also substantial decreases in the concentrations of the automotive exhaust pollutants carbon monoxide, nitrogen oxides and hydrocarbons, with the improvement of automotive engine design and the winter use of oxygenated fuels. Nitrogen oxides from automotive exhausts react with volatile organic compounds in the air, in the presence of sunlight, to produce the ground-level air contaminant, ozone. Thus, the capture of gasoline vapors during refilling of underground gasoline tanks resulted in major reductions of ozone pollution.

Table 1 summarizes the national long-term changes in pollutant emissions and ambient air concentrations for NAAQS pollutants (National Air Quality: 2000 Status and Trends, EPA, Sept. 2001). The table shows that emissions of the principal pollutants, with the exception of nitrogen oxides, decreased between 1991 and 2000. However, ozone levels have worsened in the southern and north-central regions of the United States and in 29 of our national parks. Nationally, much of the ground-level ozone pollution is caused by increased emissions of nitrogen oxides, mostly from non-road engines like construction and recreation equipment, diesel vehicles, and power plants, according to the EPA report.

Since 1970, the greatest improvement has been a 94 percent decrease in lead emissions, due to the elimination of lead from gasoline. These reductions occurred during a period of significant population and economic growth. Since 1970, total U.S. energy consumption has increased 45 percent, vehicle miles traveled have increased 143 percent, and gross domestic product has increased 158 percent.

Table 1. Changes in Emissions and Air Quality (1981-2000)

Criteria Pollutant	**Air Quality Pollutant Concentration Change**		**Pollutant Emissions Change**	
	1991-2000	**1981-2000**	**1991-2000**	**1981-2000**
Carbon Monoxide	-41%	-61%	-5%	-18%
Lead	-50%	-93%	-4%	-94%
Nitrogen Dioxide	-11%	-14%	+3% (NO_x)	+4% (NO_x)
Ozone (1-Hour) (8-Hour)	-10% -7%	-21% -12%	-16% (VOC)	-32%(VOC)
PM_{10}	-19%	n/a	-6%*	-47%*
$PM_{2.5}$	n/a	n/a	-5%*	n/a
Sulfur Dioxide	-37%	-50%	-24%	-31%

*Includes only directly emitted particles

Despite successful measures to reduce air pollution in Nevada, the Reno and Las Vegas urban areas fail to meet some of the national ambient air quality standards. The Reno area is not in attainment of the standards for carbon monoxide, inhalable particulate matter (PM_{10}) and ozone. However, there has not been a violation of the carbon monoxide standards in the Reno area since 1991, and the ozone standard has not been violated since 1990. There were violations of the 24-hour PM_{10} standard in Reno in 1990 and 1991, and there was an exceedance of the 24-hour standard in 1999. The Reno area exceeded the annual PM_{10} standard at one site until 1995 and again in 1999. The 1999 exceedances are not violations of the PM_{10} standards, which utilize averages over three years.

Washoe County, which includes the Reno area, was reclassified by EPA from nonattainment to attainment for the one-hour ozone standard on June 5, 1998. After the eight-hour ozone standard was challenged in the courts, the EPA reinstated Washoe County's non-attainment status for the one-hour ozone standard, effective December 20, 2000.

The Las Vegas area is not in attainment of the standards for carbon monoxide and PM_{10}. The monitoring data generally document improvement in carbon monoxide concentrations in the Las Vegas area between 1990 and 1997 for eight-hour averaging periods.

In Nevada, the highest 24-hour concentrations of PM_{10} are particularly susceptible to high wind conditions in dry desert terrain, and are therefore likely to show more variation than the data for other pollutants. Weather also affects pollutant levels in other ways. In the winter, when strong temperature inversions occur in basins surrounded by mountains, pollutants are trapped near ground level, causing poor air quality. Thus air pollution trends may reflect the occurrence or absence of strong inversions during winter. In the summer, ozone concentrations increase as the temperature and amount of sunlight increase.

Considering all the air quality pollutants statewide, the monitoring data generally show no deterioration in the air quality of Nevada over the report period and improvement in carbon monoxide levels.

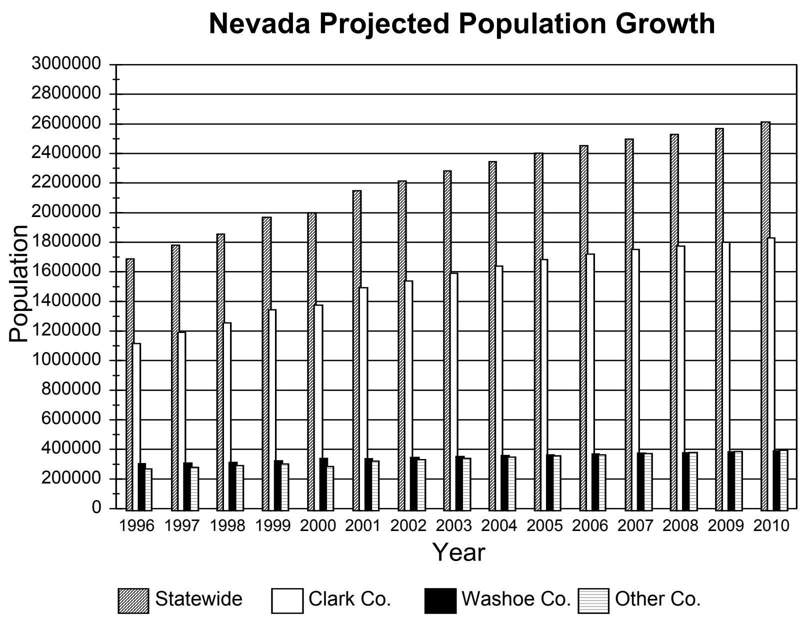
BACKGROUND

DEMOGRAPHICS

The population of the State of Nevada has increased substantially over the last three decades. Between 1960 and 1990 the statewide population increased 237 percent. In 2000 the state population increased to 1,998,257 (U.S. Census Bureau). The 2000 population for Clark County, which contains Las Vegas, was estimated at 1,375,765, and Washoe County, which contains Reno, had a population estimated at 339,486.

The Nevada State Demographer's Office completed its 2000-2010 forecasts for the State of Nevada and its counties. It is expected that the state will have a total population of 2,611,453 by the year 2010.

Population growth will be based primarily in the urban areas of the state and particularly in Clark County, which includes Las Vegas. If Clark County growth keeps up its expected pace, its population will grow 1.38 million persons to 1.83 million in 2010.



Washoe County, which includes Reno, the other major urban area of the state, will grow from 339,486 persons to 390,462 in 2010.

In 1990 the two most populous counties of Clark and Washoe comprised 83 percent of the total state population. In 2000 the same two counties accounted for 86 percent of the total state population. In 2010 it is estimated that these two counties will account for 85 percent of the statewide population.

While the largest population increases will occur in the populous counties, the highest growth rates over ten years are projected to occur in Nye County (5.2 percent); Churchill, Douglas and Lyon Counties (3.3 percent); and Pershing County (3.2 percent). The statewide growth rate is expected to be 2.6 percent over the 10-year period. Clark County is estimated to grow 2.8 percent over the period, and Washoe County is projected to grow 1.7 percent. Two counties are projected to experience population decreases over the 2000-2010 period, White Pine County (-2.6%) and Mineral County (-0.9%).

NEVADA AIR QUALITY PROGRAMS

The State of Nevada is divided into three jurisdictions which manage their own air programs by designation of the Nevada State Legislature. There are three separate and independent major monitoring networks gathering air quality data within the state. The Nevada Department of Conservation and Natural Resources, Division of Environmental Protection (NDEP), Bureau of Air Quality (BAQ) is responsible for air quality surveillance in all areas of the state other than Clark County and Washoe County. Air quality data for Clark County are collected by the Clark County Department of Air Quality Management. Air quality data for Washoe County are obtained by the Washoe County District Health Department, Air Quality Management Division. The exception to this rule is that the BAQ has air quality jurisdiction, including ambient air quality monitoring, statewide over fossil fuel-fired steam generating units (power plants). In addition to these three major monitoring networks, air quality monitoring is being conducted by the National Park Service, Air Resources Division at Lehman Caves, along the eastern border of the state near Baker.

By multiagency cooperative agreement, the California Air Resources Board has begun conducting ambient air quality monitoring on both the California and Nevada sides of the Lake Tahoe hydrographic basin. On the Nevada side of the basin, this includes monitoring for carbon monoxide at Stateline; ozone, PM_{10} and $PM_{2.5}$ at Cave Rock; and nitrogen dioxide and PM_{10} at Incline Village.

The NAAQS published by the EPA in 40 CFR Part 50 define the levels of air quality necessary to protect human health and welfare. An area is considered to be in nonattainment for a pollutant if it has violated the NAAQS (generally, more than one exceedance of the NAAQS annually) for that pollutant. Table 2 is the attainment status for the three state air programs. The federal air quality standards (NAAQS) and state air quality standards are presented in Appendix 2.

Table 2. Attainment Status for Criteria Pollutants by Air Program

Nevada Air Program	Attainment Status for Criteria Pollutants
NDEP/Bureau of Air Quality	Unclassifiable/attainment for all criteria pollutants[a]
Washoe County District Health Dept. Air Quality Management Division	Nonattainment for carbon monoxide, particulate matter (PM_{10}), and ozone[b]
Clark County Department of Air Quality Management	Nonattainment for carbon monoxide and particulate matter (PM_{10})
National Park Service Air Resource Division	Unclassifiable/attainment for all criteria pollutants

[a] The US EPA still considers the Steptoe Valley to be a nonattainment area for SO_2. The only significant source of SO_2 was eliminated and the state is working with the EPA to move this area into attainment. Similarly, the state requested redesignation of the Nevada side of the Lake Tahoe hydrographic basin into attainment of the carbon monoxide standards and submitted a limited maintenance plan to the EPA.
[b] In 1994 the Washoe County Air Quality Management Division initiated a request by the State of Nevada for EPA redesignation of Washoe County to attainment for ozone.

TYPES OF MONITORING STATIONS

Ambient air monitoring stations in this report fall into five categories:

1) National Air Monitoring Stations (NAMS)
2) State and Local Air Monitoring Stations (SLAMS)
3) National Particulate Network (NPN) Stations
4) Special Purpose Monitoring Stations (SPMS).
5) National Park Service Gaseous Air Pollutant Monitoring Network

Some sites may represent more than one of these categories.

The NAMS sites are regarded as national trend sites and are selected by federal and state environmental representatives and approved by the national NAMS site coordinator at the EPA research center.

The SLAMS sites are the long-term air quality monitoring stations located throughout the state. They are operated either by the state or by a local agency. Most air quality monitoring data are generated at SLAMS sites.

The NPN sites provided for supplementary analysis of particulate filters for substances such as metals and benzo(alpha)pyrene, a hydrocarbon. The NPN program operated until 1991.

The SPMS sites are established to determine the air quality of a relatively small area or to monitor on a temporary basis. These sites usually operate for six to 24 months, and are generally used to measure air quality in areas not previously monitored. They are also established to monitor the effects of a specific air pollution source on the surrounding air quality.

The National Park Service Gaseous Air Pollutant Monitoring Network site is used to determine the effect of air quality on the park unit's biological resources as well as the health of park unit residents and visitors.

Appendix 1 provides site descriptions and Aerometric Information Retrieval System (AIRS) site numbers for ambient air sampling stations statewide. Monitoring data may not be available for all the monitoring stations for all the years in the report period.

STATE AND FEDERAL AMBIENT AIR QUALITY STANDARDS

The state ambient air quality standards and corresponding federal ambient air quality standards are listed in Appendix 2, Table 3. Although the federal standard for ozone was supplemented effective September 16, 1997, and new standards for $PM_{2.5}$ were added, the state standards have not changed.

On September 16, 1997, the EPA promulgated a $PM_{2.5}$ standard and revisions to the ozone and PM_{10} standards. These new standards were challenged in the courts and, on May 14, 1999, a three-judge panel of the U.S. Court of Appeals for the District of Columbia Circuit vacated the new PM_{10}

standard and ruled that the new eight-hour ozone standard could not be implemented. The EPA appealed that ruling to the U.S. Supreme Court but did not appeal the loss of the new PM_{10} standard. The old PM_{10} standard remains in effect. The one-hour ozone standard was reinstated in those parts of the country where the EPA had revoked that standard in an effort to smooth the transition to the new, more protective eight-hour standard. The U.S. Supreme Court ruled that the new eight-hour ozone standard can be implemented after the EPA reconsiders its implementation plan for moving from the one-hour standard to the eight-hour standard and develops an implementation plan consistent with the Court's opinion. The $PM_{2.5}$ standard remains in effect, based on a June 18, 1999 ruling of the Appeals Court, and attainment designations will be made after three years' data have been collected. Data collection began in most parts of the country in 1999 or 2000.

Excluding the new federal standards challenged in the courts, the state standards and national primary standards are the same or approximately the same with three exceptions: ozone in the Lake Tahoe basin, carbon monoxide above 5,000 feet elevation, and sulfur dioxide for three-hour periods. For these exceptions, the state standards are more stringent than the federal standards.

Interpretation of the statewide ambient air quality data may be facilitated by recognizing that certain differences exist between the state and federal standards for the pollutants discussed and between the state and federal methods for determining exceedances and violations of the respective standards. For example, the federal and state standards for eight-hour carbon monoxide concentrations are 9 parts per million (ppm) and 9.0 ppm, respectively. As a result of rounding to the number of significant digits expressed in the standard, the federal standard is not exceeded until the concentration reaches 9.5 ppm, while the state standard is exceeded at 9.05 ppm. Furthermore, a violation is generally not incurred under federal standards until the second annual exceedance, while a violation is incurred under state standards at the first exceedance.

Determination of attainment of the national primary standards for PM_{10} and ozone is complicated by the need to round 24-hour PM_{10} concentrations to the nearest 10 Fg/m^3 and determine "expected" values based on calculations involving the most recent three or more years' data. The particulate data presented in this report have not been manipulated according to the federal method for determining attainment of the national ambient air quality standards. Instead, they are raw data suitable for comparison with the state standards.

Finally, although the state and federal ozone standard is listed as an hourly standard, the federal ozone standard is attained when, based on a three-year average, the expected number of days per year with a maximum hourly average above the standard is not more than one. The one-hour ozone standard was supplemented on September 16, 1997 with a federal eight-hour standard that is based on a three-year average of the annual fourth-highest daily maximum eight-hour average ozone concentrations.

The principal ambient air pollutants, based on public health concerns, have been identified by the U.S. Environmental Protection Agency as "criteria" pollutants. One of these pollutants, lead, has not been a widespread ambient air quality concern since the removal of lead from gasoline. The criteria pollutants of ambient air--carbon monoxide, lead, ozone, nitrogen dioxide, sulfur dioxide and suspended particulate matter as PM_{10} and $PM_{2.5}$--are discussed below.

- Carbon Monoxide

    Carbon monoxide (CO) is a colorless, odorless, poisonous gaseous pollutant. The primary sources of CO are motor vehicles and other combustion sources. It is formed from the combustion of hydrocarbon fuels from internal combustion engines, from home heating devices such as fireplaces, stoves and furnaces, and from industrial sources of combustion. Motor vehicle exhaust contributes about 60 percent of all CO emissions nationwide. In cities, as much as 95 percent or more of all CO emissions emanate from automobile exhaust. These emissions can result in high concentrations of CO, particularly in areas with heavy traffic congestion. Other sources of CO emissions include industrial processes, non-transportation fuel combustion, and natural sources such as wildfires.

    Carbon monoxide concentrations are significantly affected by meteorological conditions, with high concentrations principally occurring during inversion periods and cold weather. A temperature inversion is present when air temperature increases with altitude, so that a warm air layer traps cooler air beneath it. The increasing levels of CO are then trapped and concentrated from the lack of vertical mixing dispersion by winds. Inversions are most frequent and have the smallest mixing depths during late fall and winter, thus contributing to elevated CO levels. This problem is compounded during periods of high pressure dominance, when atmospheric stability allows little vertical or horizontal mixing. The combination of valley basins and heavy motor vehicle traffic, with seasonal influences (temperature inversions during late fall and winter months), provides for the occurrence of elevated CO levels which may be harmful to human health and welfare.

    Carbon monoxide in high concentrations can be a silent killer, as it has a strong affinity for combining with the hemoglobin of the blood. This, in turn, causes the hemoglobin to be less readily available to perform the function of carrying oxygen to the tissues. Increased automobile use through the years has been a factor in increased CO levels and health risks. People who suffer from cardiopulmonary disease, anemia, or who smoke tobacco are most likely to be affected by high CO levels. Those who may be exposed through occupational duties are also candidates for increased health risks. Lower concentrations of CO may cause such effects as headaches, diminished alertness, slower reaction time and faster blood clotting.

    Monitoring data for CO concentrations in Nevada are presented in Appendix 3, Tables 4-9.

- Lead

    In the past, automotive sources were the major contributor of lead (Pb) emissions to the atmosphere. As a result of EPA's regulatory efforts to reduce the content of Pb in gasoline, the contribution from the transportation sector has declined. Today, smelters and battery plants are the major sources of Pb emissions to the atmosphere. The highest concentrations of Pb are found in the vicinity of nonferrous smelters and other stationary sources of Pb emissions.

Exposure to Pb mainly occurs through the inhalation of air and the ingestion of Pb in food, water, soil, and dust. It accumulates in the blood, bones, and soft tissues. Excessive exposure to Pb may cause mental retardation and behavioral disorders. Even at low doses, Pb exposure is associated with changes in fundamental enzymatic, energy transfer, and homeostatic mechanisms in the body. Recent studies show that Pb may be a factor in high blood pressure and subsequent heart disease.

As a result of the elimination of Pb from gasoline, Pb concentrations in the ambient air are generally so low that monitoring for Pb is not necessary. Data for lead monitoring in the Las Vegas area during the report period are not presented in this report.

- Ozone

Ground level ozone (O_3) is a toxic gas, one of a group of complex oxidants found in the ambient air. Unlike other pollutants, O_3 is not emitted directly into the air by specific sources. Ozone is photochemical in nature, meaning that it is formed in the air by chemical reactions among nitrogen oxides, oxygen, and hydrocarbons in the presence of sunlight. Some of the more common sources are gasoline vapors, chemical solvents, combustion products of various fuels, and consumer products. These products can be frequently found in large industrial facilities, gas stations, and small businesses such as bakeries and auto body repair shops. Often these "precursor" gases are emitted in an area, but the actual chemical reaction, stimulated by sunlight and temperature, takes place in another. Combined emissions from motor vehicles and stationary sources can be carried hundreds of miles from their origins, forming high O_3 concentrations over very large regions.

Ozone in different layers of the atmosphere (i.e., stratospheric O_3 versus ground level O_3) exhibits different effects, while the physical substance remains the same. In the upper atmosphere, O_3 is produced by sunlight from oxygen in the air. Near the ground, O_3 is produced primarily from man-made compounds. It is important to note that the O_3 near the ground affects man adversely and therefore is considered a harmful pollutant. The stratospheric O_3, however, is essential to human survival, as it plays a key role in determining the temperature of the stratosphere and prevents harmful ultraviolet solar radiation from reaching the earth's surface. Over the last two decades, growing concern has been expressed for maintaining the irreplaceable high-altitude layer of this compound, while at the same time the O_3 near the ground is a harmful pollutant. Ozone is the most abundant and most reliably measured oxidant present in the air.

While O_3 in the air can be related to both natural and man-made processes, measurements indicate the high concentrations in or near large urban centers are from man-made sources.

An important factor in O_3 occurrence is the weather. Long sunny days (spring, summer and fall) induce elevated levels of O_3.

Studies have shown that continued exposure to O_3 levels of 0.3 parts per million (ppm) causes nasal and throat irritation, while short exposure to concentrated levels of 0.5 to 1.0 ppm causes changes in pulmonary function, increased airway resistance, decreased vital capacity, decreased carbon monoxide diffusing capacity, and decreased forced expiratory volume. Concentrations much less than those enumerated above affect asthmatics, impair physical performance, and can result in headaches, chest discomfort, and coughs. Even moderately vigorous exercise is likely to increase the risk of health effects from O_3. Individuals may be adversely affected by varying levels of O_3 exposure, depending on their physical condition.

Beyond public health, vegetation, including agricultural and commercial forest yields, and entire ecosystems may be affected. Ozone has been known to reduce crop yields of citrus, cotton, potatoes, soy beans, wheat, spinach and other sensitive crops, as well as cause visible injury to a variety of plant species. Ozone-related reductions in forest seed production may alter the species composition of wildlife in the ecosystem. Ozone also cracks rubber, weakens textiles, causes dyes to fade and causes certain paints and coatings to deteriorate.

In summary, the production of photochemical oxidants has clearly been related to the exhaust pollutants discharged by automobiles and emission of hydrocarbons from gasoline handling. The presence of hydrocarbons, oxides of nitrogen, and sunlight at temperatures in excess of 68EF are ideal conditions for formation of O_3 and other photochemical oxidants.

Monitoring data for O_3 concentrations in Nevada are presented in Appendix 3, Tables 10-15.

■ Nitrogen Dioxide

Nitric oxide (NO) and nitrogen dioxide (NO_2) are the two nitrogen oxides (NO_x) of primary concern to air quality control programs. Nitrogen oxides are formed by fuel combustion in automobiles, diesel vehicles, off-road construction and recreation equipment, power plants, industries, homes and offices. Nitric oxide reacts with oxygen in the air to produce NO_2. Motor vehicles and other fuel-burning processes are the main sources of NO and NO_2 in the atmosphere.

Nitrogen dioxide has been associated with adverse effects on health more than any other nitrogen oxide. At higher exposures, NO_2 causes respiratory system damage of various types, including bronchial damage. Its effects are displayed by increased susceptibility to respiratory infection and emphysematous changes. Airborne nitrogen oxides are also one of the primary sources of nitrogen pollution in certain bodies of water, such as the Chesapeake Bay.

While natural background emissions of NO_x compounds are known to exist, research has shown the levels to be many times lower than those found around metropolitan and industrialized areas. Therefore, the man-made contributions to the NO_x pollutant levels are of great concern.

Monitoring data for NO_2 concentrations in Nevada are presented in Appendix 3, Tables 16-18.

■ Sulfur Dioxide

Sulfur oxides (SO_x) commonly originate from burning fossil fuels. They also are produced industrially (e.g., smelting and chemical preparation). Sulfur dioxide (SO_2) is the criteria pollutant of concern. Examples of highly concentrated sources of SO_2 are metal smelting and oil refining industries and large oil- or coal-fired electric power plants. While fuels with lower sulfur levels have been utilized, they are more costly and less heat-efficient for industrial processes. There is an evident seasonal variation for SO_2 and, because industrial consumption does not vary much throughout the year, SO_2 is associated mainly with power generation and domestic heating.

In the air, SO_2 reacts with oxygen, ammonia and other compounds, including water vapor, to form sulfate salts and sulfuric acid mist. It is historically the most prominent of the gaseous pollutants. Sulfur dioxide was the main suspect in such disasters as the London Killer Fog Episode of 1952. In a five-day period, fog, SO_2 and a temperature inversion in the valley of the Thames River caused severe illness and an unusually large number of deaths. It is believed that SO_2, in combination with particulate pollution, provided the unhealthy environment that existed.

Sulfur dioxide primarily irritates the respiratory system. At low concentrations, it causes constriction of the bronchi. While these effects are not proportional to exposure time, continuous exposure does produce irreversible degenerative changes. Generally, for short periods of exposure, the effect is seen in the first minute or two. It is more likely to affect the elderly and those people who already suffer from respiratory diseases such as asthma, chronic bronchitis and emphysema.

Monitoring data for SO_2 concentrations in Nevada are presented in Appendix 3, Table 19.

■ Particulate Pollutants

Particulate pollutants generally consist of a mixture of particles of dust, pollen, ash, soot, metals and other various solid and liquid chemicals found in the atmosphere. The particulate data in this report deal with particulate matter in the inhalable size range of 10 microns or smaller in aerodynamic diameter (PM_{10}), or "coarse" particles, and the respirable size range of 2.5 microns or smaller in aerodynamic diameter ($PM_{2.5}$), or "fine" particles. Ten microns is about one-seventh the diameter of human hair.

Unlike the gaseous pollutants which are continuously monitored, PM_{10} may be sampled every sixth day for a 24-hour period. A sampler commonly used in PM_{10} sampling is called a high-volume sampler, which draws a known volume of air through a filter. Suspended PM_{10} in the surrounding air is collected on an eight-inch by 10-inch quartz fiber filter, which is weighed to indicate the quantity of the sample collected on it. By knowing the volume of air that passed through the filter and the weight of particles collected on the filter, the PM_{10} concentration can be calculated. The volume of air that passes through the filter in a 24-hour period is approximately equivalent to the amount of air an average adult breathes in about four months.

Meteorological conditions and other natural occurrences need to be considered when evaluating reductions in emissions for maintenance of the ambient particulate standards. While many PM_{10} emissions, or coarse particles, are from man-made sources (e.g., salt and sand deposited on roads to reduce driving hazards in winter, vehicles traveling on unpaved roads, construction dust, and rock processing), other PM_{10} pollution comes from indirect sources such as motor vehicles that carry particles which are eventually deposited on roads and subsequently agitated and suspended in the air. In addition, strong winds may cause PM_{10} concentrations to be high where the vegetation has been removed by man-made or natural causes.

Sources of $PM_{2.5}$ emissions, or fine particles, originate from fuel combustion from a variety of sources, such as motor vehicles, power generating stations, other industrial facilities, and residential fireplaces and wood-burning stoves. Fine particles also form from the interaction of chemicals, such as sulfur dioxide, nitrogen oxides, and volatile organic compounds, with other compounds in the air.

The EPA will begin analyzing $PM_{2.5}$ data collected for comparison to the new air quality standards as early as 2002. Since the national $PM_{2.5}$ network was still being deployed in 2000, three year's data for comparison to the standards may not be available until 2004 for some areas. Some $PM_{2.5}$ data collected with uncertified monitors will not be eligible for this comparison. The EPA does have $PM_{2.5}$ data collected at National Parks and other rural sites, which show that rural monitoring sites in the East typically have higher annual average $PM_{2.5}$ concentrations than in the West, and the Eastern sites have higher proportions of sulfate from coal-fired power generating stations and other industrial boilers than Western sites. Most of the $PM_{2.5}$ particles in both the East and the West consist of sulfates and organic carbon. Although visibility has improved in the eastern United States, the best days for visibility in the East are still about the same as the worst days in the West (National Air Quality: 2000 Status and Trends, EPA, Sept. 2001).

Particulate matter affects a person's health through the lungs in three ways. The first is the inhalation of toxic particles. Secondly, high levels of particles overload the clearance mechanism of the lungs, lessening their ability to remove toxic particles. Thirdly, particulate matter absorbs harmful gases and enhances the effects of those pollutants on the lungs. When particle concentrations are high, asthma and other respiratory conditions can be aggravated, causing increased coughing and chest discomfort.

Monitoring data for PM_{10} concentrations in Nevada are presented in Appendix 3, Tables 20-

23. Monitoring data for $PM_{2.5}$ concentrations in Nevada are presented in Appendix 3, Tables 24-26.

This section of the report discusses by pollutant the air quality status and trends for the monitoring jurisdictions in the state. Graphs are shown in the appendices where there are sufficient data to establish trends.

CARBON MONOXIDE (Tables 4-9)

The Nevada and federal standard for a one-hour period is 35 ppm carbon monoxide. The eight-hour average must not reach 9.05 ppm under the state standard of 9.0 ppm, and must not reach 9.5 ppm under the federal standard of 9 ppm. At altitudes above 5,000 feet, the state eight-hour standard is reduced to 6.0 ppm, because of the decrease in available oxygen at higher altitudes. It is felt that the lower level of 6.0 ppm for eight hours provides better protection of human health and welfare at high elevations. The Nevada monitoring sites at Lake Tahoe are the only monitoring sites in the state currently subject to this elevation-related state standard. Following are summaries of the findings for carbon monoxide monitoring in Nevada.

- Washoe County AQMD: Reno, Sparks, Lemmon Valley, Incline Village, Mustang (Tables 4 & 7)

  The Truckee Meadows hydrographic basin (Reno-Sparks) is designated a moderate (#12.7 ppm) nonattainment area for carbon monoxide, based on eight-hour concentrations. The last exceedance of the carbon monoxide national ambient air quality standards was recorded on December 13, 1991. At the Lemmon Valley, Incline Village, Toll and Mustang monitoring sites, carbon monoxide concentrations were low.

- Nevada BAQ: Carson City, Stateline, Minden (Tables 5 & 8)

  In Carson City, the East Fifth Street site recorded lower carbon monoxide concentrations than other Carson City sites as a result of this site's greater distance from major traffic corridors. The Roberts House and Ann Street sites in the downtown area are similar with respect to proximity to heavy upwind traffic along North Carson Street (US 395) and residential wood burning. No exceedances were recorded and there was no substantial change in concentrations over the last years that cannot be attributed to meteorological conditions. The Long Street site, a few blocks northeast of the Roberts House site, recorded concentrations close to the concentrations previously recorded at the Roberts House site.

  At Stateline, carbon monoxide concentrations monitored along the edge of the Horizon Casino Resort parking lot, downwind from the casino core area, were low, based on available data for the last two decades. Nonetheless, the Lake Tahoe hydrographic basin was designated a nonattainment area (severity of nonattainment not classified) for carbon monoxide by the EPA based on monitoring at South Lake Tahoe, California and on monitoring at Stateline in the 1970's. On June 1, 1998 the California side of the Lake Tahoe hydrographic basin was redesignated to attainment of the carbon monoxide standards. The

State of Nevada requested redesignation of the Nevada side of the Lake Tahoe hydrographic basin to attainment of the carbon monoxide standards and submitted a limited maintenance plan to the EPA. As part of this plan and by multiagency cooperative agreement, the California Air Resources Board is conducting carbon monoxide monitoring at Harvey's Resort Hotel, very close to the thoroughfare through the casino complex at Stateline.

Monitoring in Minden, started at the end of 1997, shows carbon monoxide concentrations there to be low.

- Clark County DAQM: Las Vegas, North Las Vegas, Henderson, Boulder City (Tables 6 & 9)

  The Las Vegas Valley hydrographic basin is designated a serious nonattainment area for carbon monoxide, based on eight-hour exceedances. The monitoring data generally document improvement in eight-hour carbon monoxide concentrations from 1990 to 1997. At the Henderson and Boulder City monitoring sites, carbon monoxide concentrations were generally low.

OZONE (Tables 10-15)

The federal one-hour ozone standard is attained when, based on a three-year average, the expected number of days per year with a maximum hourly average above the standard is not more than one. The 1997 federal eight-hour standard is based on a three-year average of the annual fourth-highest daily maximum eight-hour average ozone concentrations. This three-year average is not to exceed 0.08 ppm. The state ozone standard, a one-hour average concentration not to be exceeded, is 0.12 ppm. The exception is the Lake Tahoe Basin where the state standard is 0.10 ppm.

Washoe County was designated a marginal nonattainment area for ozone until June 5, 1998, when the EPA reclassified Washoe County, which includes the Reno area, as an attainment area for the one-hour ozone standard. This reclassification was in response to the implementation of the new eight-hour ozone standard, which substitutes for the one-hour standard in areas where the one-hour standard was not exceeded for some time.

Washoe County had not exceeded the national ambient air quality standard for ozone since February 25, 1990. In the summer of 1994, the Washoe County Air Quality Management Division therefore initiated a request by the State of Nevada for EPA redesignation of Washoe County to attainment for ozone. This request was not acted upon by the EPA. Because the new eight-hour ozone standard was challenged in the courts, Washoe County's designation reverted to a marginal nonattainment area for the ozone one-hour standard effective December 20, 2000.

None of the rest of the state is designated nonattainment for the one-hour ozone standard. Although rare exceedances of the standard were recorded, there were no violations of the federal standard in the rest of the state, because the expected annual number of exceedance days at any site was not more than one. Classifications with regard to the new eight-hour ozone standard have not been done by the EPA, although the state has submitted its eight-hour ozone designation requests to the EPA.

NITROGEN DIOXIDE (Tables 16-18)

The standard for nitrogen oxide compounds is related to the levels of nitrogen dioxide (NO_2). The state standard for nitrogen dioxide, expressed as the annual arithmetic mean (yearly average), is 0.05 ppm. The federal nitrogen dioxide annual standard is 0.053 ppm.

There are no areas in Nevada designated nonattainment areas for nitrogen dioxide. SLAMS monitoring for nitrogen dioxide has been performed in Las Vegas, Stateline, and Carson City, and special purpose monitoring is being done in Reno. Nitrogen dioxide concentrations are generally less than two-thirds of the standard statewide, and outside Las Vegas and Reno are generally not over one-fifth of the standard.

SULFUR DIOXIDE (Table 19)

Because sulfur dioxide can have long-term as well as short-term effects, three separate standards have been established. The first health-related, or primary, standard is the annual arithmetic mean (yearly average). A yearly safe exposure level of 0.03 ppm has been established for the public. The other health-related standard, a 24-hour (daily) average, is 0.14 ppm. The federal secondary standard and state standard require that an exposure for a three-hour period not exceed an average of 0.5 ppm.

The state and local agencies did not operate sulfur dioxide monitoring sites for most of the report period. Monitoring data from industrial sources indicate that the sulfur dioxide standard was not violated during the period under review.

In 1993 the Clark County Department of Air Quality Management began monitoring sulfur dioxide concentrations. The concentrations monitored, which are low in comparison to the standards, are presented in Appendix 3, Table 19.

The central Steptoe Valley in the Ely area is still listed as not meeting primary standards for SO_2. This designation is based on copper smelting activity at McGill that ceased operation in 1983. The smelter smokestack was demolished years ago. The Nevada Bureau of Air Quality has initiated a request by the State of Nevada for the EPA to reclassify this area to attainment.

PARTICULATE MATTER AS PM_{10} (Tables 20-23)

The total suspended particulates (TSP) standards were abandoned in favor of the PM_{10} standards by the EPA in 1987 and by the state in 1991. The PM_{10} standards recognize the important health effects of particles in the inhalable size range, while eliminating from consideration the larger suspended particles previously sampled under the TSP standard. The PM_{10} annual standard is 50 $\mu g/m^3$. The 24-hour PM_{10} standard is 150 $\mu g/m^3$. As discussed in the section on state and federal ambient air quality standards, the federal 24-hour PM_{10} standard is based on the number of expected exceedances from the analysis of three or more years' data.

The number of exceedances of the 24-hour standard can be affected by the sampling schedule, when samples are not collected on an every-day schedule. For example, the number of exceedances monitored may need to be multiplied by six when sampling is on an every-sixth-day schedule, or be multiplied by three when sampling is on an every-third-day schedule. An every-sixth-day schedule can be identified when the number of samples for a complete calendar year approaches 61; an every-third-day schedule can be identified when the number of samples for a complete calendar year approaches 122. Following are summaries of the findings for PM_{10} monitoring in Nevada:

- Washoe County AQMD: Reno, Sparks, Sun Valley, Incline Village, Mustang (Table 20)

  The Truckee Meadows hydrographic basin (Reno-Sparks) is designated a serious nonattainment area for PM_{10}, effective February 7, 2001. The EPA announced in November 2000 that it proposed changing this PM_{10} nonattainment designation from "moderate" to "serious," based on a 1999 violation of the 24-hour standard and the violations of the PM_{10} standards in the early 1990's. The last exceedance of the 24-hour PM_{10} national ambient air quality standard prior to 1999 was recorded on January 25, 1993. The year 1995 was the first year the Truckee Meadows basin was below the annual PM_{10} standard at all monitoring sites, but the annual standard was exceeded again in 1999. At the sites outside Reno, PM_{10} concentrations were generally low.

- Nevada BAQ: Carson City, Minden, Gardnerville, Stateline, Fernley (Table 21)

  At these sites, PM_{10} concentrations were well below the annual and 24-hour standards. An exceedance of the 24-hour standard in Carson City on January 10, 1997 was excluded from consideration in making regulatory determinations, because the EPA classified the exceedance an exceptional event related to silt deposition from a flood.

- Nevada BAQ: Elko, Lovelock, Fallon, McGill, Lehman Caves, Battle Mountain (Table 22)

  At these sites, PM_{10} concentrations were below the annual and 24-hour standards. In Battle Mountain during 1990, one exceedance of the 24-hour standard was excluded from regulatory determinations as an exceptional event due to high winds. Exceedances of the 24-hour standard on August 13, 1996 in McGill and on October 18, 1996, April 23, 1998 and January 11, 2000 in Battle Mountain were excluded as natural events due to high winds. An exceedance of the 24-hour standard in Battle Mountain on August 2, 2000 was flagged by the Bureau of Air Quality as a natural event for wildfire smoke. Flagging of this exceedance by the EPA is pending. PM_{10} data from one site in Lovelock, the high school, were disqualified by the EPA due to siting concerns. There were no other exceedances of the 24-hour or annual standards for the years reported at these locations.

- Clark County DAQM: Las Vegas, North Las Vegas, Henderson, Jean, U.S. Highway 93, Boulder City (Table 23)

  The Las Vegas Valley hydrographic basin is designated a serious nonattainment area for PM_{10} by the EPA based on violations of the 24-hour and annual standards.

PARTICULATE MATTER AS $PM_{2.5}$ (Tables 24-26)

The annual $PM_{2.5}$ standard is met when the three-year spatial average of the annual averages of the monitors in an area does not exceed 15.0 µg/m^3. The 24-hour $PM_{2.5}$ standard is met when the three-year average of the annual 98^{th} percentile concentrations at each monitoring site does not exceed 65 $\mu g/m^3$. As discussed under the heading, Particulate Matter as PM_{10}, the number of exceedances can be affected by the sampling schedule when every-day sampling is not done. Attainment classifications based on three years of data collected with EPA-certified federal reference method (FRM) monitors are not yet available, since monitoring for $PM_{2.5}$ was scheduled by the EPA to start in 1999. Monitoring in Washoe County commenced in 1999 with FRM monitors. Clark County monitoring sites started operating with uncertified monitors in1997 and with FRM monitors in 1999. No monitoring for $PM_{2.5}$ was required by the EPA for the rest of the state. Screening monitoring was conducted at three locations in the rest of the state beginning in 1998 and 1999 with uncertified monitors, which are not as labor-intensive as FRM monitors. The screening monitoring indicated that $PM_{2.5}$ concentrations were low at all three locations: Carson City, Gardnerville, and Fernley.

The data collected with certified FRM monitors suitable for comparison with the standards show no exceedances of the 24-hour or annual standards statewide during the first two years of monitoring.